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ABSTRACT:

A pump of the sliding-vane type or pivoted-vane type comprises a rotor (12) eccentrically mounted in a bore (11) of a housing. Vanes (17) on the rotor engage with a rotatable cylindrical sleeve (18) supported in the bore (11) by a hydrodynamic bearing, fluid therefor being introduced through bores (25). Lubricant channels (29) may be formed in the rotor end-faces. The wall of the bore (11) and/or the outer surface of the sleeve (18), and also the rotor end-faces and/or the inner surfaces of the housing end-walls, may be coated with a material having a low coefficient of friction e.g. a plastics material containing particles of graphite, molybdenum disulphide or P.T.F.E. <IMAGE>

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(54) Rotary Positive-displacement Pumps

(57) A pump of the sliding-vane type or pivoted-vane type comprises a rotor (12) eccentrically mounted in a bore (11) of a housing. Vanes (17) on the rotor engage with a rotatable cylindrical sleeve (18) supported in the bore (11) by a hydrodynamic bearing, fluid therefor being introduced through bores (25). Lubricant channels (29) may be formed in the rotor end-faces. The wall of the bore (11) and/or the outer surface of the sleeve (18), and also the rotor end-faces and/or the inner surfaces of the housing end-walls, may be coated with a material having a low coefficient of friction e.g. a plastics material containing particles of graphite, molybdenum disulphide or P.T.F.E.

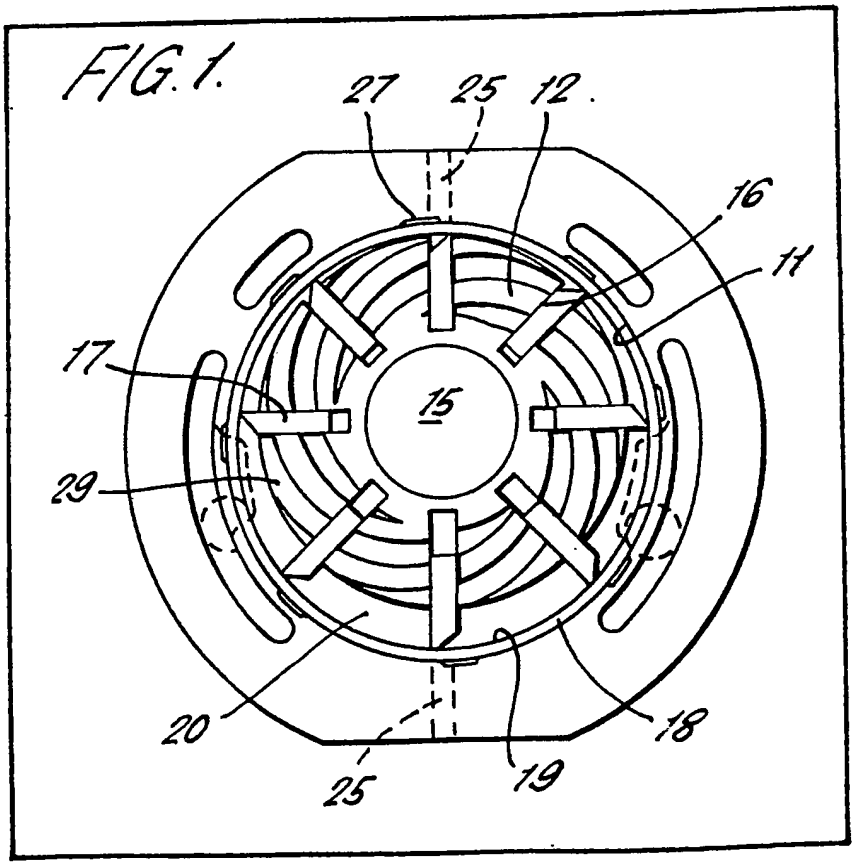

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FIG. 1.

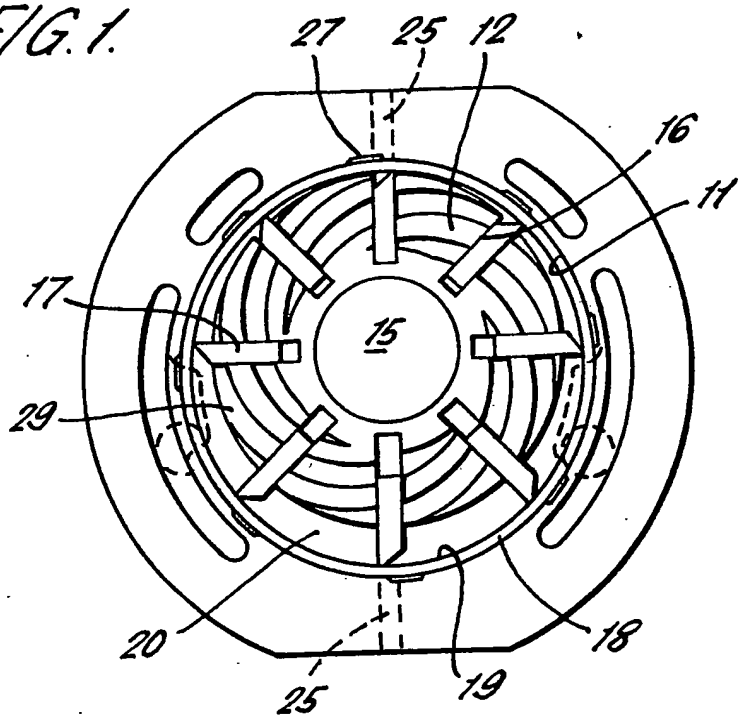
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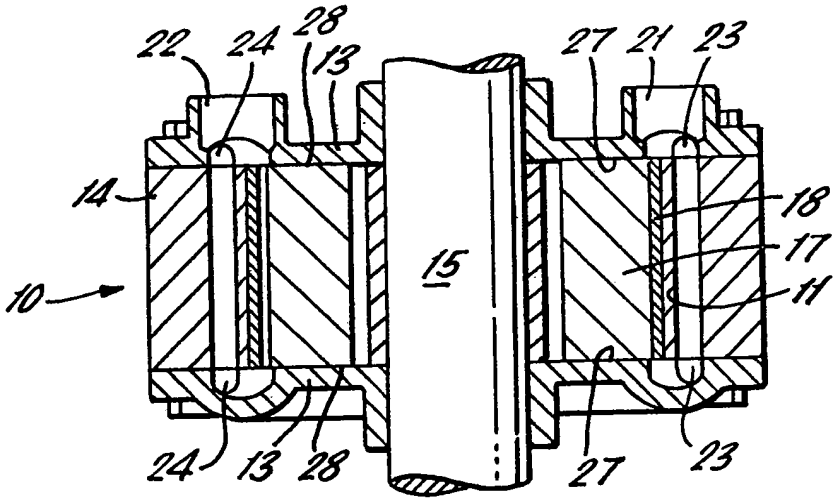
FIG. 2.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SPECIFICATION
A Vane Pump

This invention concerns a vane pump.

Generally there are two types of vane pump. Common to both types is a rotor eccentrically mounted in the bore of a housing. With the first type of vane pump, the rotor has a number of longitudinal slots extending radially, and a plurality of vanes mounted one in each slot for radial movement. With the second type of vane pump, the vanes are pivotally connected to the rotor for movement about axes extending parallel to that of the rotor. Rotation of the rotor relative to the housing in both types of vane pump causes the vanes to be urged radially outwardly by centrifugal action and slidingly engage the bore of the housing.

The sliding of the vanes on the bore surface of the housing causes a lot of wear so that the pump fails relatively quickly, and the friction between the surfaces means that there is a loss of power.

The invention provides a vane pump comprising a housing having a bore, a rotor mounted eccentrically in the bore for rotation relative to the housing, vanes mounted on the rotor and a cylindrical sleeve disposed in the bore of the housing around and eccentrically of the rotor and the vanes, the sleeve being rotatable relative to the housing and the vanes, at least in use of the pump, slidingly engaging the bore surface of the sleeve.

In use of the pump, the cylindrical sleeve rotates with the rotor, the vanes in effect dragging the sleeve around. Consequently there is little wear of and little friction between the vanes and the bore of the sleeve because there is little if any relative movement between them.

So that the cylindrical sleeve rotates smoothly and easily relative to the housing, a bearing may be provided between the radially opposed surfaces of the cylindrical sleeve and the bore of the housing.

The bearing may be a hydrodynamic bearing and one of the radially opposed surfaces of the cylindrical sleeve and the bore of the housing may have pockets for the reception of lubricant. Alternatively one of the opposed surfaces may have helical grooves or channels for the passage of lubricant. To optimise the friction and supporting capacity, one of the opposed surfaces may have surrounding grooves or protuberances.

The bearing may be an hydrostatic bearing and the bore of the housing may have pockets and the housing may have bores opening into the pockets for the supply of lubricant under pressure.

The bearing may be a plain or sliding bearing and one or both of the radially opposed surfaces of the cylindrical sleeve and the bore of the housing may have a coating of a material having a lower coefficient of friction than that of the said surfaces. The coating may contain particles of a lubricating material such as graphite, molybdenum disulphide or polytetrafluoroethylene.

To further reduce the power losses due to friction, the rotor and the housing have pairs of axially opposed surfaces and one of the surfaces of each pair may have grooves or channels for the passage of lubricant, and the grooves or channels may extend spirally. Alternatively one or both of the surfaces of each pair may have a coating of a material having a lower coefficient of friction lower than that of the said surfaces. The coating may contain particles of a lubricating material such as graphite, molybdenum disulphide or polytetrafluoroethylene.

An embodiment of the invention will now be described by way of example, reference being made to the accompanying drawings, of which:—

Figure 1 is an end view of a vane pump according to the invention with an end plate of the housing removed to show the interior of the pump; and

Figure 2 is a longitudinal section through the vane pump of Figure 1 with the end plate in position.

The vane pump shown in the drawings comprises a housing 10 having a cylindrical bore 11, and a cylindrical rotor 12 eccentrically mounted in the housing. The housing 10 comprises two end plates 13 and a cylindrical part 14, providing the bore 11, mounted between and fixed to the end plates. The rotor 12 is mounted on and for rotation with a shaft 15. The rotor 12 has a plurality of longitudinal radially extending slots 16, and a plurality of generally flat plate-like vanes 17 are disposed one in each slot for radial movement relative to the rotor. In the illustrated embodiment, there are eight slots 16 and eight vanes 17.

A cylindrical sleeve 18 having a bore 19 is disposed in, and for rotation relative to, the bore 11 of the housing 10 and extends around the rotor 12 and vanes 17 and eccentrically of the rotor. A crescent-shaped chamber 20 is formed between the rotor 12 and the bore 19 of the sleeve 18.

One of the housing end plates 13 has an inlet opening 21 and an outlet opening 22. From inlet opening 21, a passage 23 for the fluid being pumped extends through the cylindrical part 14 of the housing 10 to the other end plate 13. Similarly a passage 24 extends from the outlet opening 22 through the cylindrical part 14 of the housing 10 to the other end plate 13.

Upon rotation of the rotor 12 in the clockwise direction when looking at Figure 1, the vanes 17 are urged radially outwardly by centrifugal action and slidingly engage the bore 19 of the sleeve 18. The fluid being pumped is drawn in through inlet 21 and along passage 23, is passed along the crescent-shaped chamber 20 and is expelled through passage 24 and outlet 22.

The vanes 17 engaging the sleeve 18 cause the sleeve to rotate with the rotor 12 and relative to the housing 10. Consequently, there is little, if any, relative circumferential movement between the vanes 17 and the sleeve 18 so that there is

little frictional losses between and little wear of the vanes and the sleeve.

In order to ensure that the sleeve 18 can rotate smoothly in the bore 11 of the housing 10, lubricant is conducted through radial apertures 25 in the housing to between the radially opposed surfaces of the bore 11 and the sleeve 18. Upon rotation of the rotor 12, and thus rotation of the sleeve 18 relative to the bore 11 of the housing 10, a film of lubricant is hydrodynamically built up separating the radially opposed surfaces of the sleeve and the bore of the housing. Pockets 26 can be formed in the bore 11 of the housing 10, which pockets improve the formation of the lubricant film. The radial depth of the pockets 26 decreases in one circumferential direction, that is, they are wedge-shaped.

The end plates 13 of the housing 10 have inwardly axially facing surfaces 27 opposing axially facing surfaces 28 of the rotor 12. Each face 28 of the rotor 12 is provided with spirally extending grooves or channels 29 so that lubricant passed along these channels forms a film between the opposed surfaces 27 and 28 thus reducing the friction between the rotor and the housing.

Modifications to the described and illustrated embodiment are envisaged. The pockets 27 in the bore 11 of the housing 10 can instead be provided on the outer surface of the sleeve 18; also the spiral channels 29 in the axially facing surfaces 28 of the rotor 12 can instead be provided on the axially facing surfaces 27 of the end plates 13 of the housing 10.

Instead of an hydrodynamic bearing with pockets 27 being formed in one of the radially opposed surfaces of the sleeve 18 and the bore 11 of the housing 10, an hydrodynamic bearing having helically extending grooves can be formed on one or both of those opposed surfaces. Also an hydrostatic bearing can be formed between those radially opposed surfaces with pressure pockets formed in the bore 11 of the housing 10 and apertures in the housing opening into the pockets for the supply of lubricant under pressure.

If the fluid being pumped must be kept clean, one or both of the radially opposed surfaces of the sleeve 18 and the bore 11 of the housing 10, and one or both of the axially opposed surfaces 27 and 28 of the rotor 12 and the end plates 13 of the housing can be coated with a layer of material, such as a plastics, having a coefficient of friction lower than that of the surfaces. This coating forms a kind of dry plain or sliding bearing. Particles of a lubricating material such as graphite, molybdenum disulphide and polytetrafluorethylene can be incorporated in the coating.

Finally, although the embodiment of the invention described and illustrated has been of a vane pump having radially slidable vanes, the invention is equally applicable to a vane pump having pivoting vanes.

Claims

1. A vane pump comprising a housing having a bore, a rotor mounted eccentrically in the bore for rotation relative to the housing, vanes mounted on the rotor and a cylindrical sleeve disposed in the bore of the housing around and eccentrically of the rotor and the vanes, the sleeve being rotatable relative to the housing and the vanes, at least in use of the pump, slidingly engaging the bore surface of the sleeve.

2. A vane pump as claimed in claim 1, wherein a bearing is provided between the radially opposed surfaces of the cylindrical sleeve and the bore of the housing.

3. A vane pump as claimed in claim 2, wherein the bearing is an hydrodynamic bearing.

4. A vane pump as claimed in claim 3, wherein one of the radially opposed surfaces of the cylindrical sleeve and the bore of the housing has pockets for the reception of lubricant.

5. A vane pump as claimed in claim 3, wherein one of the radially opposed surfaces of the cylindrical sleeve and the bore of the housing has helical channels for the passage of lubricant.

6. A vane pump as claimed in any one of claims 3 to 5, wherein one of the radially opposed surfaces of the cylindrical sleeve and the bore of the housing has surrounding grooves or protuberances.

7. A vane pump as claimed in claim 2, wherein the bearing is an hydrostatic bearing.

8. A vane pump as claimed in claim 7, wherein the bore of the housing has pockets, and the housing has bores opening into the pockets for the supply of lubricant under pressure.

9. A vane pump as claimed in claim 2, wherein one or both of the radially opposed surfaces of the cylindrical sleeve and the bore of the housing has a coating of a material having a lower coefficient of friction than that of the said surfaces.

10. A vane pump as claimed in any preceding claim, wherein the rotor and the housing have pairs of axially opposed surfaces and one of the surfaces of each pair has grooves for the passage of lubricant.

11. A vane pump as claimed in claim 10, wherein the grooves extend spirally.

12. A vane pump as claimed in any one of claims 1 to 9, wherein the rotor and the housing have pairs of axially opposed surfaces and one or both of the surfaces of each pair has a coating of a material having a coefficient of friction lower than that of said surfaces.

13. A vane pump as claimed in claim 9 or 12, wherein the coating contains particles of a lubricating material.

14. A vane pump as claimed in claim 13, wherein the particles are graphite, molybdenum disulphide, or polytetrafluoroethylene.

15. A vane pump substantially as herein described with reference to and as shown in the accompanying drawings.

16. Rotary piston machine, especially cell-type pump, with rotary piston mounted eccentrically in a housing and slide members arranged on the

circumference of the rotary piston in apertures, displaceable to and fro substantially radially and resting on a bore eccentric of the rotation axis of the rotary piston, characterised in that a cylindrical sleeve is arranged in the bore of the housing for rotation in relation to the housing.

17. Rotary piston machine according to claim 16, characterised in that a bearing is arranged between the bore of the housing and the periphery of the cylindrical sleeve.

18. Rotary piston machine according to claim 17, characterised in that a hydrodynamic plain bearing is arranged between the bore of the housing and the periphery of the cylindrical sleeve.

19. Rotary piston machine according to claim 18, characterised in that the periphery of the sleeve and/or the bore of the housing is provided with lubricant pockets.

20. Rotary piston machine according to claim 18, characterised in that the periphery of the sleeve and/or the bore of the housing is provided with spiral channels which build up pressure.

21. Rotary piston machine according to one of claims 18 to 20, characterised in that the periphery of the sleeve or the bore of the housing is provided with surrounding grooves or protuberances.

22. Rotary piston machine according to claim 17, characterised in that a hydrostatic bearing is arranged between the bore of the housing and the periphery of the cylindrical sleeve.

23. Rotary piston machine according to claim 22, characterised in that the bore of the housing is provided with hydrostatic pressure pockets into which there enter feed bores for lubricant under pressure.

24. Rotary piston machine according to claim 17, characterised in that the periphery of the sleeve and/or the bore of the housing is provided with a coating of a friction-reducing material.

25. Rotary piston machine according to claim 24, characterised in that the coating of friction-reducing material contains particles of a self-lubricating material as for example graphite, molybdenum disulphide or the like.

26. Rotary piston machine according to one of claims 16 to 25, characterised in that the rotary piston is provided on the faces or the housing lids are provided on the faces with grooves for the supply of lubricant.

27. Rotary piston machine according to claim 26, characterised in that the grooves are formed as spiral channels.

28. Rotary piston machine according to one of claims 16 to 25, characterised in that the rotary piston is provided on the faces and/or the housing lids are provided on the faces with a coating of a friction-reducing material.

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